

REMARKS

With the entry of the present amendments, Claims 1-17 are pending in the application. Claims 18-33 were previously cancelled. Claim 1 has been amended. Support for the claim amendment may be found throughout the application as filed, including, but not limited to, paragraph 46.

In view of the following remarks, reconsideration and withdrawal of the rejections to the application in the Office Action are respectfully requested.

I. Rejection of Claims under 35 U.S.C. § 103(a) over Wagner in view of Hubbell and Schössler.

Claims 1-8, 13 and 14 remain rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent Application Publication No. 2002/0110932, issued to Wagner *et al.* (hereinafter “Wagner”) in view of U.S. Patent Application Publication No. 2002/0128234, issued to Hubbell *et al.* (hereinafter “Hubbell”) and further in view of U.S. Patent No. 4,822,681, issued to Schössler *et al.* (hereinafter “Schössler”). Applicants respectfully traverse.

Neither Wagner nor Hubbell teaches reactions between gas-phase epoxy-functional molecules and surface hydroxyl groups. The Examiner attempts to overcome the shortcomings in the teachings of Wagner and Hubbell by pointing out that Schössler teaches the reaction of glycidoxypropyltriethoxsilane with the hydroxyl groups on a hydroxyl group-containing surface and further teaches that “It is particularly advantageous to effect the activation in gaseous phase through employment of aerosols or by means of underpressure.” However, Schössler does not teach a method of treating a surface of a substrate that includes the step of “reacting *epoxy groups* on gas-phase epoxy-functional molecules with the surface hydroxyl groups *in situ* in the absence of plasma to provide epoxy-terminated surface-bound spacer chains,” as recited in amended claim 1. Rather, Schössler teaches a method that includes the step of reacting silico-functional groups on silico-functional molecules with surface hydroxyl groups on synthetic polymers. (See col. 3, line 68 through col. 4, line 8.) Although the silico-functional molecules may also include epoxy functionalities, as in the case of glycidoxypropyltriethoxsilane, these

epoxy functionalities are not reacted with the hydroxyl groups on the polymer surfaces in the gas phase reactions of Schössler. Thus, at best, Schössler teaches the possibility of a gas-phase reaction between silico-groups on gas-phase organosilane molecules and hydroxyl groups on a polymer surface. As such, this teaching provides one of ordinary skill in the art with no information, teaching or suggestion regarding the desirability, or even the possibility, of carrying out gas-phase reactions between *epoxy groups* on epoxy-functional gas-phase molecules and surface hydroxyl groups. Therefore, the disclosure of Schössler does not make it obvious to carry out the reactions of Wagner by reacting surface hydroxyl groups with the epoxy group of a gas-phase epoxy-functional molecule. For this reason, Applicants respectfully request that the rejection of claims 1-8, 13 and 14 be withdrawn.

II. Rejection of Claims under 35 U.S.C. § 103(a) over Wagner in view of Hubbell, Schössler and Laibinis.

Claims 9 and 10 were rejected under 35 U.S.C. § 103(a) as unpatentable over Wagner in view of Hubbell, Schössler and P.C.T. Patent Application Publication No. WO 01/83826, issued to Laibinis *et al.* (hereinafter “Laibinis”). Applicants respectfully traverse.

Claims 9-10 each depend from claim 1. Claim 1 is patentable over the combination of Wagner, Hubbell and Schössler for the reasons discussed in Section I, above. Like Wagner, Hubbell and Schössler, Laibinis provides one of ordinary skill in the art with no information, teaching or suggestion regarding the desirability, or even the possibility, of carrying out gas-phase reactions between *epoxy groups* on epoxy-functional *gas-phase* molecules and surface hydroxyl groups, and certainly fails to suggest the desirability or feasibility of carrying out a reaction between a *gas-phase* epichlorohydrin molecule and a surface hydroxyl group.

Laibinis’ disclosure of reactions between epichlorohydrin and hydroxy groups is limited to the following statement: “In another embodiment, the glass surface is modified with hydroxyl groups using reagents such as hydroxypropyltriethoxysilane. Subsequent reaction of the hydroxy moiety with epichlorohydrin provides a surface having attached epoxide functional groups.” (Page 19, lines 13-15.) Thus, Laibinis describes a method wherein a hydroxy-functional layer of

an organosilane is provided on a glass surface, and this organosilane is subsequently reacted with epichlorohydrin.

Laibinis provides no explanation of how the “subsequent reaction of the hydroxy moiety with epichlorohydrin” would be conducted. In the absence of any prior art teaching of gas-phase reactions between epichlorohydrin and surface hydroxy groups, one of ordinary skill in the art would naturally employ conventional methods to carry out the reaction suggested by Laibinis. Such methods are solution-phase methods that take place, for example, by via the ring-opening addition of epichlorohydrin to an hydroxy group in the presence of an acid or alkaline catalyst, followed by a ring-closing reaction via dehydrohalogenation in an alkaline environment. In solution, the presence of water facilitates the reaction by solvating charges species. Such mechanisms do not have an obvious gas-phase counterpart.

Applicants are aware of no prior art describing a reaction between gas-phase epichlorohydrin molecules and hydroxy groups immobilized on and bound to inorganic oxide surfaces. As discussed in Section I, above, Schössler fails to provide such prior art because Schössler is directed solely to gas phase reactions between *silico* groups on organosilanes and surface hydroxy groups. As such, the teachings of Schössler are inapplicable to the patentability analysis of the pending claims. The knowledge of solution-phase reaction mechanisms between hydroxy groups and epoxy groups is, likewise, inapplicable because, in the absence of acids, alkaline catalysts and surrounding water molecules, such mechanisms could not be carried out in the gas phase. In fact, the invention recited in claims 9 and 10 is based, at least in part, on the inventors’ surprising discovery that epoxy ring-opening and ring-closing steps do take place when gas-phase epihalohydrin molecules react with surface hydroxy groups to provide epoxy-terminated, surface-bound spacer chains. Such a result could not have been predicted based upon the teachings of Laibinis or knowledge of the solution-phase chemistry of epoxy-functional molecules. Therefore, the combined teachings of Laibinis, Wagner, Hubbell and Schössler fail to render claims 9 and 10 obvious, and Applicants respectfully request that the rejection of these claims be withdrawn.

III. Rejection of Claims under 35 U.S.C. § 103(a) over Wagner in view of Hubbell, Schössler and Devoe.

Claims 11 and 12 were rejected under 35 U.S.C. § 103(a) as unpatentable over Wagner in view of Hubbell, Schössler and P.C.T. Patent Application Publication No. WO 01/96452, filed by Devoe *et al.* (hereinafter “Devoe”). Applicants respectfully traverse.

Claims 11 and 12 each depend from claim 1. As discussed in Section I, above, Claim 1 is patentable over the combination of Wagner, Hubbell and Schössler because the combined teachings of Wagner, Hubbell and Schössler fail to suggest the desirability or even feasibility of carrying out gas-phase reactions between *epoxy groups* on epoxy-functional, gas-phase molecules and surface hydroxyl groups. It follows that the combined teachings of these references also fail to suggest the desirability or feasibility of carrying out a reaction between a *gas-phase diepoxide* molecule and a surface hydroxyl group. Devoe fails to cure this deficiency.

In support of the rejection of claims 11 and 12, the Examiner states: “Devoe *et al.* teaches that numerous commercially available epoxy resins including 1,4-butanediol diglycidyl ether can be used on a solid surface (Abstract and p. 13, line 12). Therefore, it would have been an obvious matter of design choice to modify Wagner *et al.* in view of Hubbell *et al.* and Schössler *et al.* to include 1,4-butanediol diglycidyl ether of Devoe *et al.* as epoxy-functional molecules ...”

Even assuming (strictly for the sake of argument) that the Examiner’s contention is correct, the teachings of Devoe would not make it an obvious matter of design choice to modify Wagner in view of Hubbell and Schössler to react *gas-phase* 1,4-butanediol diglycidyl ether molecules with surface-bound hydroxy groups. Devoe does not contemplate gas-phase reactions between 1,4-butanediol diglycidyl ether and a surface. Instead, Devoe provides the following description of the application of compositions containing epoxy resins to surfaces: “The compositions may be applied by coating methods such as knife, bar, reverse roll, and knurled roll coating, or by application methods such as dipping, immersion, spraying, brushing, curtain coating and the like. Alternatively, the compositions can be applied drop-wise.” (Page 37,

lines 25-28.) Each of these coating methods applies to epoxy resins in a liquid state. Therefore, the teachings of Devoe fail to remedy the shortcomings of the combined teachings of Wagner, Hubbell and Schössler.

Because the Examiner has failed to identify any prior art teaching that would suggest the desirability or even feasibility of reacting epoxy-groups of *gas-phase* diepoxide molecules with surface-bound hydroxy groups on an inorganic oxide surface, as recited in claims 11 and 12, Applicants request that this rejection be withdrawn.

IV. Rejection of Claims under 35 U.S.C. § 103(a) over Wagner in view of Hubbell, Schössler and Dang.

Claims 15-17 were rejected under 35 U.S.C. § 103(a) as unpatentable over Wagner in view of Hubbell, Schössler and U.S. Patent Application Publication No. 2002/0113478, issued to Dang *et al.* (hereinafter “Dang”). Applicants respectfully traverse.

Claims 15-17 each depend from claim 1. As discussed in Section I, above, Claim 1 is patentable over the combination of Wagner, Hubbell and Schössler because the combined teachings of Wagner, Hubbell and Schössler fail to suggest the desirability or even feasibility of carrying out *gas-phase* reactions between *epoxy groups* on epoxy-functional, *gas-phase* molecules and surface hydroxyl groups. Dang fails to cure this deficiency.

The Examiner has failed to identify, and Applicants were unable to locate, any teaching in Dang regarding: (1) reactions between epoxy groups on *gas-phase*, epoxy-functional molecules and surface-bound hydroxy groups; or (2) reactions between *gas-phase* spacer molecules with epoxy-terminated, surface-bound spacer chains. Therefore, the teachings of Dang fail to remedy the shortcomings of the combined teachings of Wagner, Hubbell and Schössler, and Applicants respectfully request that the rejection of claims 15-17 be withdrawn.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a credit card payment being in the wrong amount, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741.

In view of the foregoing remarks, Applicants respectfully submit that all of the claims remaining in the Application are in condition for allowance, and favorable action thereon is respectfully requested. The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

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